STUDY & EVALUATION SCHEME WITH SYLLABUS

FOR

B. TECH 4th YEAR MANUFACTURING TECHNOLOGY

ON

CHOICE BASED CREDIT SYSTEM

(EFFECTIVE FROM THE SESSION: 2019-20)
### SEVENTH SEMESTER

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#### DEPARTMENTAL ELECTIVE-3

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<td>RPI070</td>
<td>Advance Material Technology</td>
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<td>RAU072</td>
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<td>RME073</td>
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<td>RMT075</td>
<td>Total Quality Management</td>
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<td>RMT076</td>
<td>Maintenance Engg. &amp; Management</td>
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<tr>
<td>RMT077</td>
<td>Process Planning &amp; Cost Estimation</td>
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### EIGHT SEMESTER

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- Students who was not-place in any company, it is mandatory to select any one subject from DE-5 & 6.
- Students who was place in any company, it is mandatory to select MOOC subject in both DE-5 & 6.

#### DEPARTMENTAL ELECTIVE-5

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<td>RPI083</td>
<td>Supply Chain Management</td>
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<td>RMT080</td>
<td>Quality Engg. in Manufacturing</td>
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<td>RPI081</td>
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<td>RPI086</td>
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<td>RPI087</td>
<td>Innovation &amp; Entrepreneurship</td>
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#### OR

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<td>RMT081</td>
<td>Mathematical Modeling of Manufacturing Processes.</td>
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#### OR

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<tr>
<td>RAU088</td>
<td>Design for Quality, Manufacturing &amp; Assembly.</td>
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SEMESTER-VII
UNIT I:
Overview:
Brief Introduction to CAD and CAM – Manufacturing Planning, Manufacturing Control.

UNIT II:
Production, planning, control and computerised process planning:
Aggregate Production Planning and The Master Production Schedule – Material Requirement Planning – Capacity Planning- Control Systems-Shop Floor Control-Inventory Control.

UNIT III:
Cellular manufacturing:
Group Technology (GT), Part Families – Parts Classification and Coding – Simple Problems in Opitz Part Coding System.

UNIT IV:
Flexible manufacturing system (FMS) and Automated guided vehicle system (AGVS):

UNIT V:
Industrial robotics:

Books and References:


UNIT- I:
Automation:
Definition, Advantages, goals, types, need, laws and principles of Automation. Elements of Automation.
Fluid power and its elements, application of fluid power, Pneumatics vs. Hydraulics, benefit and limitations of pneumatics and hydraulics systems, Role of Robotics in Industrial Automation.

UNIT- II:
Manufacturing Automation:
Classification and type of automatic transfer machines; Automation in part handling and feeding, Analysis of automated flow lines, design of single model, multi model and mixed model production lines.
Programmable Manufacturing Automation CNC machine tools, Machining centres, Programmable robots, Robot time estimation in manufacturing operations.

UNIT- III:
Robotics:
Robot anatomy, configuration of robots, joint notation schemes, work volume, manipulator kinematics, position representation, forward and reverse transformations, homogeneous transformations in robot kinematics, D-H notations, kinematics equations, introduction to robot arm dynamics.

UNIT -IV:
Robot Drives and Power Transmission Systems:
Mechanical transmission method: Gear transmission, Belt drives, Rollers, chains, Links, Linear to Rotary motion conversion, Rotary-to-Linear motion conversion, Rack and Pinion drives, Lead screws, Ball Bearings.
Robot end Effectors:
Classification of End effectors – active and passive grippers, Tools as end effectors, Drive system for grippers. Mechanical, vacuum and magnetic grippers. Gripper force analysis and gripper design.

UNIT- V:
Robot Simulation:
Methods of robot programming, Simulation concept, Off-line programming, advantages of offline programming.
Robot Applications:

Books and References:
3. Robotic: Control, Sensing, Vision and Intelligence, by Fu, McGraw Hill.
4. Introduction to Industrial Robotics, by Nagrajan, Pearson India.
5. Robotics, by J.J. Craig, Addison-Wesley.
List of Experiments: (At least 8 of the following)

Students are advised to use design data book for the design. Drawing shall be made wherever necessary on small drawing sheets.

1. Design & drawing of Cotter joint.  
2. Design & drawing of Knuckle joint.  
3. Design of machine components subjected to combined steady and variable loads.  
4. Understanding and use of any 3-D Modelling Software commands.  
6. 3-D modelling of carburettor.  
7. 3-D modelling of Spur Gear.  
8. 3-D modelling and assembly of Bench Vies.  
9. 3D modelling and assembly of safety valve use in boilers.  
10. Design and drawing of helical spring.  
11. Design and drawing of screw jack.
List of Experiments: The practical can include the following topics:

UNIT-I:
Artificial Muscles:
After a general overview of artificial muscle technologies used in robotics, the students fabricate dielectric elastomer actuators (DEAs) by hand and test the mechanical and electrical properties of their devices, comparing their results with theoretical predictions.

UNIT-II:
Outdoor Flying Robots:
This is a practical exercise on the design of a combined altitude and speed controller for a miniature autonomous airplane.
Mobile robot position estimation and navigation:
The goal of this practical is to implement position estimation and navigation on a real mobile robot.

UNIT-III:
Teaching Robots to Accomplish a Manipulation Task:
In this robotic practical, the student will be teaching a robot to build a tower by stacking several objects on top of each other.
Industrial Robot Control:
The goal is to control a robot specifically designed for tasks such as assembly, manipulation or packaging where there is need of fast and precise actions.

UNIT-IV:
Haptics:
After a brief overview of the state of the art of haptic devices, the students need to generate useful sensations in respect to a given problem, study the type of sensations that can be produced, as well as how they can be programmed.
Assembly, programming and characterization of a modular fish robot:
This practical is aimed at realizing a swimming fish robot using the same modules used for the Salamandra robotica II and AmphiBot III robots.
UNIT-I:
Overview of Composite material: Classifications of Engineering Materials, Concept of composite materials.
Matrix materials, Functions of a Matrix, Desired Properties of a Matrix, Polymer Matrix (Thermosets and Thermoplastics), Metal matrix, Ceramic matrix, Carbon Matrix, Glass Matrix etc.

UNIT-II:
Types of Reinforcements/Fibers:
Role and Selection of reinforcement materials.
Types of fibres: Glass fibers, Carbon fibers, Aramid fibers, Metal fibers, Alumina fibers, Boron Fibers, Silicon carbide fibers, Quartz and Silica fibers, Multiphase fibers, Whiskers, Flakes etc.
Mechanical properties of fibres:
Material properties that can be improved by forming a composite material and its engineering potential.

UNIT-III:
Various types of composites:
Classification based on Matrix Material: Organic Matrix composites, Polymer matrix composites (PMC), Carbon matrix Composites or Carbon-Carbon Composites, Metal matrix composites (MMC), Ceramic matrix composites (CMC).
Classification based on reinforcements: Fiber Reinforced Composites, Fiber Reinforced Polymer (FRP) Composites, Laminar Composites, Particulate Composites.

UNIT-IV:
Fabrication methods:
Processing of Composite Materials: Overall considerations, Autoclave curing, Other Manufacturing Processes like filament welding, compression moulding, resin transplant method, pultrusion, pre-peg layer, Fiber-only performs, Combined Fiber-Matrix performs.

UNIT-V:
Testing of Composites and Analysis:
Mechanical testing of composites, tensile testing, Compressive testing, Intra-laminar shear testing, Inter-laminar shear testing, Fracture testing etc.
Analysis of laminated plates: equilibrium equations of motion, energy formulation, static bending analysis, buckling analysis, free vibrations, natural frequencies.

Books and References:
UNIT-I:
Overview:

UNIT-II:
Electro-Rheological & piezoelectric materials:
Basics, Principles and instrumentation and application of Magnetorheological fluids – Piezoelectric materials: polymers and ceramics, mechanism, properties and application. Introduction to electro-restrictive and magneto-restrictive materials.

UNIT-III:
Shape memory materials:
Classification of SMA alloys- mechanism of magnetic SMA – applications of SMA – continuum applications of SMA fasteners – SMA fibers – reaction vessels, nuclear reactors, chemical plant, etc. – micro robot actuated by SMA.
SMA memorization process (Satellite Antenna Applications) SMA blood clot filter – Impediments to applications of SMA – Shape memory polymers– mechanism of shape memory-Primary moulding – secondary moulding– types and applications.

UNIT-IV:
Orthopaedic and dental materials:

UNIT-V:
Applications of materials:
substitutes – extracorporeal blood circulation devices.
The lungs – vascular implants: vascular graft, cardiac valve prostheses, card– Biomaterials in ophthalmology –skin grafts -connective tissue grafts – tissue adhesives – drug delivery methods and materials.

**Books and References:**
UNIT-I:  
**Project Management Concepts:**
Introduction, project characteristics, taxonomy of projects, project identification and formulation. Establishing the project and goals.  
Nature & context of project management; phases of PM, A framework for PM issues, PM as a conversion process, project environment & complexity.  
Organizing human resources, organizing systems & procedures for implementation. Project direction.

UNIT-II:  
**Project Organization & Project Contracts:**  
Introduction, functional organization, project organization, matrix organization, modified matrix organization.  
Pure project organization, selection of project organization structure, project breakdown structures, project contracts, types of contracts, types of payments to contractors.

UNIT-III:  
**Project Appraisal & Cost Estimation:**  
Introduction, technical appraisal, commercial appraisal, economic appraisal, financial appraisal, management appraisal, social cost/benefit analysis, project risk analysis.  
Cost analysis of the project, components of capital cost of a project, modern approach to project performance analysis.

UNIT-IV:  
**Project Planning & Scheduling:**  
Introduction to PERT & CPM, planning and scheduling networks, time estimation, determination of critical path, CPM model, event slacks & floats, PERT model.  
Expected time for activities, expected length of critical path, calculating the project length and variance, PERT & CPM cost accounting systems, lowest cost schedule, crashing of networks, linear programming formulation of event-oriented networks, updating of networks, LOB technique.

UNIT-V:  
**Modification & Extensions of Network Models:**  
Complexity of project scheduling with limited resources, resource levelling of project schedules, resource allocation in project scheduling - heuristic solution.  
Precedence networking- examples with algorithm, decision networks, probabilistic networks, computer aided project management essential requirements of PM software, software packages for CPM. Enterprise- wide PM, using spread sheets for financial projections.

**Books and References:**  
1. Project Management by Harvey Maylor, Pearson India.  
5. Project Management: A Life Cycle Approach by Kanda, PHI, India.  
UNIT-I:
Overview of AM:
History and Advantages of Additive Manufacturing, Distinction Between Additive Manufacturing and CNC Machining, Types of Additive Manufacturing Technologies, Nomenclature of AM Machines.

Direct and Indirect Processes:
Prototyping, Manufacturing and Tooling.

Layer Manufacturing Processes:
Polymerization, Sintering and Melting, Extrusion, Powder-Binder Bonding, Layer Laminate Manufacturing, Other Processes; Aerosol printing and Bio plotter.

UNIT-II:
Development of Additive Manufacturing Technology:
Computer Aided Design Technology, Other Associated Technology, Metal and Hybrid Systems.
Generalized Additive Manufacturing Process Chain; The Eight Steps in Additive Manufacturing, Variation from one AM Machine to Another, Metal System, Maintenance of Equipment, Material Handling Issue, Design of AM.

UNIT-III:
Additive Manufacturing Processes:
Vat Photopolymerization, Materials, Reaction Rates, Photopolymerization Process Modelling, Scan Patterns.

Powder Bed Fusion Processes:

Material Jetting:

Directed Energy Deposition Processes:

Direct Write Technologies:
Ink-Based DW, laser Transfer DW, Thermal Spray DW, Beam Deposition DW, Liquid Phase Direct Deposition, Hybrid Technologies.

UNIT-IV:
Design & Software Issues:
Additive Manufacturing Design and Strategies; Potentials and Resulting Perspectives, AM based New Strategies, Material Design and Quality Aspects for Additive Manufacturing; Material for AM, Engineering Design Rules for AM.

Software Issue for Additive Manufacturing:
Introduction, Preparation of CAD Models: The STL file, Problem with STL file, STL file Manipulation, Beyond the STL file, Additional Software to Assist AM.

UNIT-V:
Material Design & Quality Aspects:

**Applications:**
Aerospace, Automotive, Manufacturing, Architectural Engineering, Art, Jewellery, Toys, Medical, Biomedical, Dental, Bio-printing, Tissue & Organ Engineering and many others.

**Books and References:**
UNIT-I:  
Introduction to New Product Development.  
Tasks of detailed design, new frontiers of Computer-Aided Design tools.

UNIT-II:  
Reverse Engineering:  
Objectives and common application fields.  
Existing technologies.  
Contact systems.  
Non-contact systems.  
Manipulation of acquired data.  
Practical experiences.

UNIT-III:  
Introduction to the Basic Principles of Additive Manufacturing.  
Design for Additive Manufacturing.

UNIT-IV:  
Rapid Prototyping technologies:  
For polymers with a particular focus on Stereolithography (SLA) and Fused Deposition Modelling (FDM).  
For metals.  
For other materials.  
Practical experiences.

UNIT-V:  
Employment of Reverse Engineering and Rapid Prototyping technologies in different industrial fields with an outlook on the South Tyrolean industrial fabric.

Course Outcomes:  
Students will acquire basic knowledge about the main opportunities provided by Reverse Engineering and Rapid Prototyping tools, which represents an opportunity to learn how to conduct detailed product design by benefitting from cutting-edge technologies.

Books and References:  
2. Hacking the Xbox: An Introduction to Reverse Engineering.  
4. The Art of Memory Forensics: Detecting Malware and Threats in Windows, Linux, and Mac Memory.  
7. Practical Reverse Engineering: x86, x64, ARM, Windows Kernel, Reversing Tools, and obfuscation.
UNIT -I:
Quality Concepts:
Evolution of Quality control, concept change, TQM Modern concept, Quality concept in design.

Control on Purchased Product:
Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure.

Manufacturing Quality:
Methods and Techniques for manufacture, Inspection and control of product, Quality in sales and services, Guarantee, analysis of claims.

UNIT -II:
Quality Management:
Organization structure and design, Quality function, decentralization, Designing and fitting organization for different types products and company, Economics of quality value and contribution, Quality cost, optimizing quality cost, seduction programme.

TQM Principles:
Leadership, strategic quality planning; Quality councils - employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal.
Continuous process improvement; PDCE cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.

UNIT -III:
Tools and Techniques:
Seven QC tools (Histogram, Check sheet, Ishikawa diagram, Pareto, Scatter diagram, Control chart, flow chart).

Control Charts:
Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts, P-charts and C-charts.

UNIT -IV:
Defects Diagnosis and Prevention:
Defect study, identification and analysis of defects, corrective measure, factors affecting reliability, MTTF, calculation of reliability, Building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle.

UNIT -V:
IS0 and its concept of Quality Management:
Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements, documentation, Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits. TQM implementation in manufacturing and service sectors, Auditing, Taguchi method, JIT in some details.

Books and References:
7. Total Quality Management by Mukherjee, P.N.
UNIT-I:
Principles and practices of maintenance planning:

UNIT-II:
Maintenance policies – preventive maintenance:
Maintenance Categories – Comparative Merits of Each Category – Preventive Maintenance, Maintenance Schedules, Repair Cycle – Principles and Methods of Lubrication – TPM.

UNIT-III:
Condition monitoring:

UNIT-IV:
Repair methods for basic machine elements:

UNIT-V:
Repair methods for material handling equipment:

Books and References:
UNIT-I:
Overview of process planning:
Introduction- methods of process planning-Drawing Interpretation-Material evaluation – steps in process selection-. Production equipment and tooling selection.

UNIT-II:
Process planning activities:
Process parameters calculation for various production processes-Selection jigs and fixtures election of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies.

UNIT-III:
Introduction to cost estimation:
Importance of costing and estimation –methods of costing-elements of cost estimation.

UNIT-IV:
Production cost estimation:

UNIT-V:
Machining time calculation:
Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations, Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding.

Books and References:
SEMESTER-VIII
UNIT-I:
Overview of NDT:
Scope and advantages of NDT, Comparison of NDT with Destructive Testing, some common NDT methods used since ages, Terminology, Flaws and Defects, Visual inspection.
Equipment used for visual inspection. Ringing test, chalk test (oil whitening test). Uses of visual inspection tests in detecting surface defects and their interpretation, advantages & limitations of visual inspection.

UNIT-II:
Tests:
Die penetrate test (liquid penetrate inspection), Principle, scope. Equipment & techniques, Tests stations, Advantages, types of penetrants and developers, Zyglo test, Illustrative examples and interpretation of defects.
Magnetic particle Inspection – scope and working principle, Ferro Magnetic and Nonferromagnetic materials, equipment & testing. Advantages, limitations Interpretation of results, DC & AC magnetization, Skin Effect, use of dye & wet powders for magna glow testing, different methods to generate magnetic fields, Applications.

UNIT-III:
Radiographic methods:
Introduction to electromagnetic waves and radioactivity, various decays, Attenuation of electromagnetic radiations, Photo electric effect, Rayleigh’s scattering (coherent scattering), Compton’s scattering (Incoherent scattering), Pair production, Beam geometry and Scattering factor.

UNIT-IV:
Ultrasonic testing methods:
Introduction, Principle of operation, Piezoelectricity. Ultrasonic probes, CRO techniques, advantages, Limitation & typical applications.
Applications in inspection of castings, forgings, Extruded steel parts, bars, pipes, rails and dimensions measurements. Case Study – Ultrasonography of human body.

UNIT-V:
Special NDT Techniques:
Introduction to Holography, Thermography and Acoustic emission Testing.

Books and References:
7. Practical non destructive testing by Raj, Baldev.
UNIT-I:
**Overview of SCM:**
Role of Logistics and Supply Chain Management: Scope and Importance- Evolution of Supply Chain -Decision Phases in Supply Chain. Competitive and Supply Chain Strategies – Drivers of Supply Chain Performance and Obstacles.

UNIT-II:
**Supply chain network design:**

UNIT-III:
**Logistics in supply chain:**

UNIT-IV:
**Sourcing and coordination in supply chain:**

UNIT-V:
**Supply chain and information technology:**
The Role IT In Supply Chain- The Supply Chain IT Frame Work Customer Relationship Management – Internal Supply Chain Management – Supplier Relationship Management – Future of IT In Supply Chain –E-Business in Supply Chain.

Books and References:
UNIT-I:
Overview:
Different Definitions and Dimensions of Quality, Historical Perspective (From Evolution of Quality Control, Assurance and Management to Quality as Business Winning Strategy), Contribution of Renowned Quality Gurus (Their Philosophies and Impact on Quality).

UNIT-II:
Quality Engineering and Management Tools, Techniques & Standards:
7 QC tools, 7 New Quality Management Tools, 5S Technique, Kaizen, Poka-Yoke, Quality Circle, Cost of Quality Technique.

UNIT-III:
Total Quality Management:
Basic Philosophy, Approach, Implementation Requirements & Barriers.
Designing for Quality:
Introduction to Concurrent Engineering, Quality Function Deployment (QFD) and Failure Mode and Effect Analysis (FMEA) – Concept, Methodology and Application (with case studies).

UNIT-IV:
Introduction to Design of Experiments:
Introduction, Methods, Taguchi approach, Achieving robust design, Steps in experimental design.

UNIT-V:
Contemporary Trends in Quality Engineering & Management:
Just in time (JIT) Concept, Lean Manufacturing, Agile Manufacturing, World Class Manufacturing, Total Productive Maintenance (TPM), Bench Marking, Business Process Re-engineering (BPR).
Six Sigma - Basic Concept, Principle, Methodology, Implementation, Scope, Advantages and Limitation of all as applicable.
Quality in Service Sectors:
Characteristics of Service Sectors, Quality Dimensions in Service Sectors, Measuring Quality in Different Service Sectors.

Books and References:
2. Quality Control & Application by B. L. Hanson & P. M. Ghare, Prentice Hall of India.
5. Total Quality Management – Dr. S. Kumar, Laxmi Publication Pvt. Ltd.
7. Statistical Quality Control by M. Mahajan, Dhanpat Rai & Co. (P) Ltd.
UNIT-I:
Overview:
SEVEN forms of waste and their description; Historical evolution of lean manufacturing;
Global competition, Customer requirements, Requirements of other stake holders.
Meaning of Lean Manufacturing System (LMS), Meaning of Value and waste, Need for
LMS, Symptoms of underperforming organizations, Meeting the customer requirement,
Elements of LMS.

UNIT-II:
Primary tools used in LMS:
Meaning and Purpose of 5S Work place organization, 5S process – Sort, set in order, Shine,
Standardize, Sustain, implementing 5S.
Meaning and purpose of TPM, Pillars of TPM, Conditions for TPM success, TPM
implementation process, Overall Equipment Effectiveness and problems on computation of
OEE.

UNIT-III:
Process Mapping and Value Stream Mapping (VSM) – Need for process maps, advantages,
types and its construction, steps in preparing VSM.
Concept of work Cell and its design, Line balancing algorithms and problems.

UNIT-IV:
Secondary tools used in LMS:
Cause and effect diagram, Pareto chart, Radar chart, Poke Yoke, Kanban, Automation,
SMED, Standardized fixture, DFMA, JIT.
Visual workplace, problems on Pareto analysis and computation of number of kanbans.

UNIT-V:
LMS Rules:
Stability, Management, Standardized work, Pull system, Continuous improvement. Lean
Implementation: Training, selecting the projects, preparing project charter, project
implementation, Project review.
Implementing LMS for higher productivity: Operator, process, machinery and equipment,
workplace organization, Inventory, LMS Design Process.

Books and References:
UNIT -I:
Quality Concepts:
Evolution of Quality control, concept change, TQM Modern concept, Quality concept in design.
Control on Purchased Product:
Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure.
Manufacturing Quality:
Methods and Techniques for manufacture, Inspection and control of product, Quality in sales and services, Guarantee, analysis of claims.

UNIT -II:
Quality Management:
Organization structure and design, Quality function, decentralization, Designing and fitting organization for different types products and company, Economics of quality value and contribution, Quality cost, optimizing quality cost, seduction programme.
TQM Principles:
Leadership, strategic quality planning; Quality councils - employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal.
Continuous process improvement; PDCE cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.

UNIT -III:
Tools and Techniques:
Seven QC tools (Histogram, Check sheet, Ishikawa diagram, Pareto, Scatter diagram, Control chart, flow chart).
Control Charts:
Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts, P-charts and C-charts.

UNIT -IV:
Defects Diagnosis and Prevention:
Defect study, identification and analysis of defects, corrective measure, factors affecting reliability, MTTF, calculation of reliability, Building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle.

UNIT -V:
ISO and its concept of Quality Management:
Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements, documentation, Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits. TQM implementation in manufacturing and service sectors, Auditing, Taguchi method, JIT in some details.

Books and References:
7. Total Quality Management by Mukherjee, P.N.
UNIT-I:
Planning, scheduling and control of flexible manufacturing systems:

UNIT-II:
Computer control and software for flexible manufacturing systems:

UNIT-III:
FMS simulation and data base:

UNIT-IV:
Group technology and justification of FMS:

UNIT-V:
Applications of FMS and factory of the future:

Books and References:
UNIT-I:
Overview of reliability engineering:
Definition of reliability, Failures & failures modes, Failure rates, MTTF, MTBF, Bath tub curve, Definition and factors influencing system effectiveness, various parameters of system effectiveness.

UNIT-II:
Reliability analysis:

UNIT-III:
Types of reliability:

UNIT-IV:
Improvement in reliability:
Reliability Improvements: Methods of reliability improvement, component redundancy, system redundancy, types of redundancies-series, parallel, series - parallel, stand by and hybrid, effect of maintenance.

UNIT-V:
Testing methods:
Reliability Testing, Life testing, requirements, methods, test planning, data reporting system, data reduction and analysis, reliability test standards.

Books & references:
UNIT-I:
Should You Become an Entrepreneur?
What Skills Do Entrepreneurs Need?
Identify and Meet A Market Need.
Entrepreneurs in A Market Economy.
Select A Type of Ownership.

UNIT-II:
Develop A Business Plan.

UNIT-III:
Choose Your Location and Set Up for Business.
Market Your Business.
Hire and Manage A Staff.

UNIT-IV:
Finance, Protect and Insure Your Business.
Record Keeping and Accounting.
Financial Management.

UNIT-V:
Meet Your Legal, Ethical, Social Obligations.
Growth in Today’s Marketplace.

Books & references:
2. Innovation and Entrepreneurship by Peter Drucker.
3. Running Lean: Iterate from Plan A to a Plan That Works by Ash Maurya.
4. The Ten Faces of Innovation by Tom Kelley and Jonathan Littman.
5. The Innovator’s Dilemma by Clayton M. Christensen.
6. The Invisible Advantage: How to Create a Culture of Innovation by Soren Kaplan.